United States
Department of
Agriculture

Forest Service

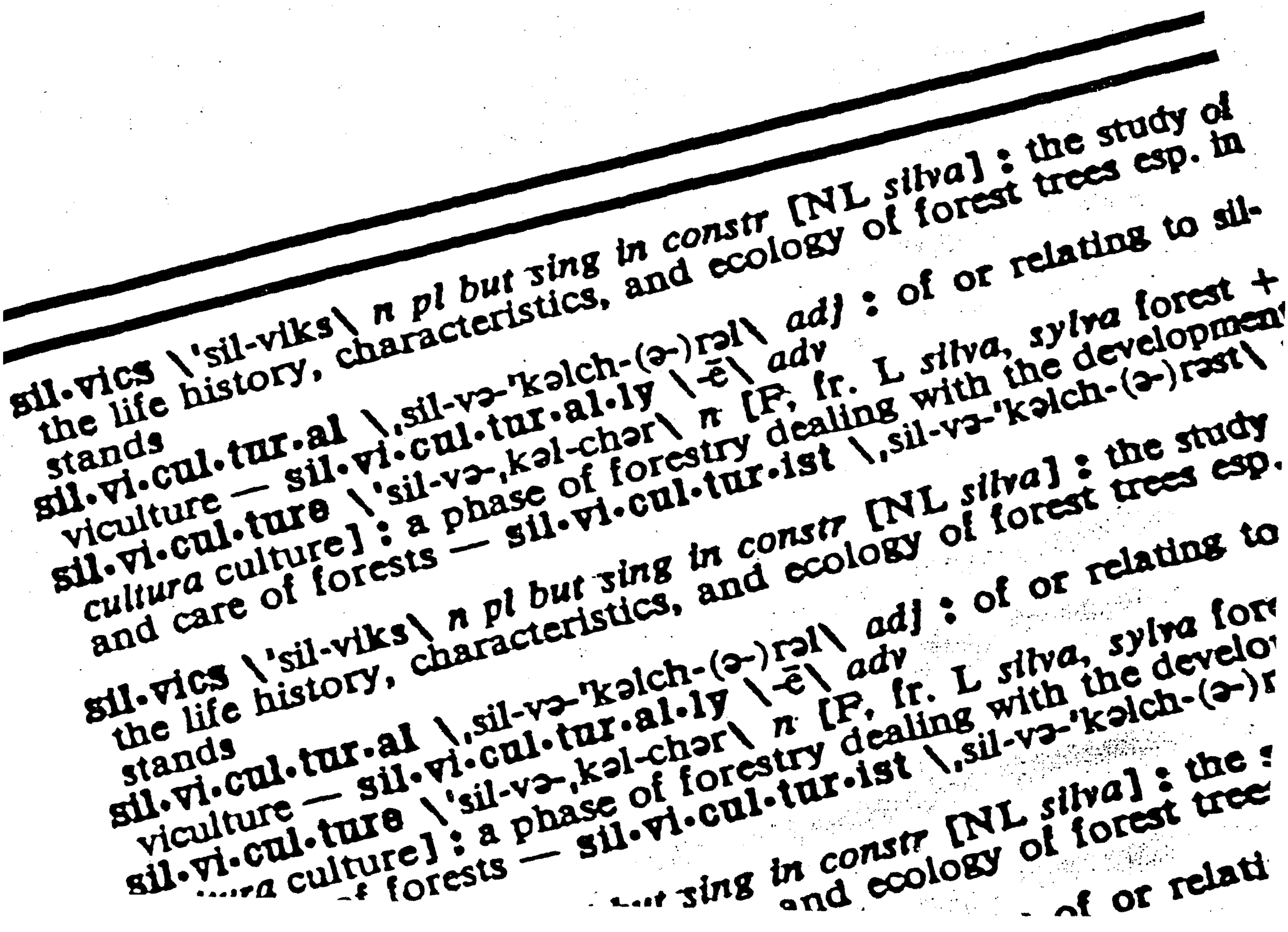
Southeastern Forest
Experiment Station

General Technical Report
SE-42

Proceedings of the

Fourth Biennial Southern Silvicultural Research Conference

Atlanta, Georgia
November 4-6, 1986



Proceedings of the Fourth Biennial Southern Silvicultural Research Conference

Compiled by
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Atlanta, Georgia
November 4-6, 1986

Sponsored by

Southern Forest Experiment Station

Southeastern Forest Experiment Station

Southern Region of the
National Association of Professional
Forestry Schools and Colleges

Southern Industrial Forestry
Research Council

Silvicultural Working Group—
Society of American Foresters

Published by

Southeastern Forest Experiment Station
Asheville, North Carolina
1987

THE EFFECT OF SEED TREATMENT AND SOWING METHOD

ON GERMINATION OF OCALA SAND PINE 1/

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Abstract.-- Ocala sand pine (Pinus clausa var. clausa D. B. Ward) seeds, half of them presoaked and half untreated, were sown in a greenhouse study in fine sand soil at moisture contents (by weight) of 2, 5, and 10 percent by pressing into the soil, by broadcasting and covering with soil, or by broadcasting and covering with soil which was packed. In a second test presoaked and control seeds were sown in soil at 3, 5, and 7 percent moisture by pressing into the soil. Soil at 2 percent moisture content was too dry for any germination even if seeds were presoaked. The seeding method had no effect on speed of germination or total germination. Presoaking seeds resulted in more rapid germination in both tests and at the 5 percent soil moisture content an increase in total germination of about 20 percent in the first test. Most of the time soil moisture will be between wilting point, about 2 percent, and field capacity, about 10 percent. Thus, presoaking may be a way to increase seed germination. In addition presoaking could reduce losses to predation by speeding up germination. Although presoaking appears beneficial and did not have any negative effects on viability of seeds lying in dry soil, field tests are needed before a final evaluation can be made.

INTRODUCTION

Ocala sand pine (Pinus clausa var. clausa D.B. Ward) is native to the droughty, acid, infertile, marine deposited sandhills of Florida. The largest concentration occurs in the center of the state on an area known as the Central Highlands. The understory is primarily evergreen shrubs 6 to 10 feet tall with very little herbaceous ground cover (Laessle 1958). Typical understory species are sand live oak (Quercus virginiana var. geminata (Small) Sarg.), myrtle oak (Q. myrtifolia Willd.), Chapman oak (Q. chapmanii Sarg.), and palmetto (Sabal spp.). This area has hot, humid summers, somewhat dry winters, and a long growing season of 269 to 312 days. Precipitation is abundant, 53 to 60 inches per year, and is fairly well distributed (Burns and Hebb 1972).

Sandhills soils are acid, infertile and droughty marine deposits from the interglacial stages of the Pleistocene epoch. Because of sorting action during deposition, they are largely quartz sands, ranging from a few feet to more than 20 feet deep. Organic matter content is low because the climate promotes rapid oxidation. Because of the low levels of organic matter and of clay colloids, cation exchange capacities and moisture retention of these soils are low (Burns and Hebb 1972). Due to the soil's low moisture-holding capacity, drought conditions can exist within 2 weeks of a heavy rainfall. Also surface temperatures of exposed soils may reach 140° F on summer days, which is why these areas have been called deserts in the rain (Burns and Hebb 1972).

Ocala sand pine begins cone production at an early age, about 5 years, and has abundant annual crops (Barnett and McLemore 1965). The cones are predominately serotinous and persist on the tree for many years. Most natural stand have originated from seed released by the serotinous cones following wildfires. Attempts have been made to get natural regeneration by using the heat from the sun to open cones in logging slash, but stocking has been below acceptable levels (Price 1973). Burning logging slash to release seeds has also been tried, but it gave poor results because available cones were unevenly distributed and the fire destroyed many seeds (Cooper et al., 1959).

Ocala sand pine can be planted, but due to its lack of true winter-type dormancy (Zelawski and Strickland 1973), survival is generally poor, about 60 percent, and variable (Burns and Hebb 1972, Hebb and Burns 1973). The most successful and economical system for regeneration has been clearcutting, site preparation, and direct seeding (Price 1973). Seed is broadcast at a rate of 0.5 to 1.0 pound per acre following site preparation by double chopping with a heavy, duplex brush cutter. Research and experience has shown that

1/ Paper presented at Southern Silvicultural Research Conferrence, Atlanta, Georgia, November 4-6, 1986.

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some method of covering the seed with a layer of soil 0.25 to 0.75 inches thick will reduce seed predation and increase germination (Burns and Hebb 1972).

Although broadcast seeding has been the most successful system for regeneration of Ocala Sand Pine it has not been entirely satisfactory. Many areas, especially during years with extended drought periods, which occur about 3 years out of 10, fail to regenerate adequately. In addition many areas are overstocked and require precommercial thinning to prevent stand stagnation. In an attempt to improve spacing, eliminate precommercial thinning, and reduce costs, a new system using a bracke scarifier-seeder was recently employed. This system was very successful the first year, but since then almost all of the areas seeded with it have failed, as have the majority of the areas that were broadcast seeded. If the success ratio could be improved by even a small margin it would result in considerable savings. Two areas where gains might possibly be made are improving the seeding method or pretreating the seed.

The specific purpose of this study was to determine if packing the soil over the seed or presoaking the seeds in water would increase germination and if there were any interactions between packing, soil moisture content, presoaking and germination.

METHODS

A sample of the Ocala sand pine seed from four different seed lots being used for regeneration during the 1985-86 season was obtained from personnel on the Ocala National Forest. All seeds were from cones collected on the Ocala National Forest and processed by the National Tree Seed Laboratory. Processing included extraction, cleaning, and coating with Arasan and Aluminum powder. Prior to study initiation seeds were tested for viability on germination paper in boxes at the Olustee Laboratory, Florida. Because all lots had similar and high viabilities of about 80 percent, all tests were done using a mixture of seeds from all lots.

A split-plot factorial design was used in both portions of the study. All germination tests were done in 6.75 x 4.75 x 2.25 inch germination boxes under greenhouse conditions at the Olustee Laboratory. Control seeds were planted in half of each germination box and presoaked seeds in the other half. Presoaking was done in tap water at 38° F for 24 hours. Upon removal from cold storage the water was drained from soaked seeds and they were blotted dry enough with towels so they would not stick together and then planted. In the first test, soil from the E horizon of a Blanton fine sand (loamy, siliceous, thermic grossarenic paleudult) with moisture content by weight of 2, 5, or 10 percent was used in factorial combinations with seed planted three ways: by pressing into the soil; broadcasting and covering with soil; or broadcasting and covering with soil which was then packed. these moisture levels were chosen to represent effective wilting point, minimally adequate, and field capacity and the methods were to simulate drilling in seeds, the present system of sowing, and present system with the addition of a packing wheels, respectively. In the second test the surface A and E horizons from a Paola sand (hyperthermic, uncoated spodic quartzipsamment) soil at moisture contents of 3, 5, and 7 percent with three replications was used and all seeds were planted by pressing into the soil.

The number of seedlings emerging from the soil was counted in each box at weekly intervals for three weeks following sowing. At the end of the initial three weeks in the second study, enough moisture was added to the boxes that originally had 3 percent water to bring them to 10 percent and these were monitored for an additional three weeks. Percent germination data were analyzed by analysis of variance for each test by individual week.

RESULTS AND DISCUSSION

There was not enough moisture available at the 2 percent level for any germination to occur. This was expected since this moisture level was included to represent soil at the effective wilting point. Germination was also very limited (about 3 percent) at the 3 percent soil moisture level. The sowing method used had no effect on total germination which was 79, 77, and 74 percent for broadcast, cover and pack; drill; and broadcast and cover, respectively. As could be expected, total germination increased with percent soil moisture (Table 1 and 2). Presoaking seeds significantly increased the speed of germination, especially in the first test. The increased speed of germination may be due to the higher moisture level of presoaked seeds, 22 versus 8 percent for normal seeds, since it is quite likely seed must reach a critical moisture level before certain physiological processes necessary for germination can begin. However, presoaking may just increase the ability of the seeds to imbibe water, since Barnett and McLemore (1965) found soaking sand pine seeds in 95 percent ethanol also increased the speed of germination. In the first test presoaking also increased total germination at the 5 percent soil moisture level (Table 1). It may be that with limited moisture the presoaking allows a few more of the seeds to reach the critical level. The results of the second test, however, were contradictory as total germination was not effected at any soil moisture level by presoaking (Table 2). This may be due to the lower overall germination rate of this test.

Table 1.-- Effect of presoaking on germination of Ocala sand pine seed at soil moisture contents of 5 and 10 percent.

Days after sowing	Treatment	Germination at soil moisture level 5-percent	10-percent	mean
			Percent	
6	Presoaked	25	23	24a[1/]
	Control	7	3	5b
	Mean		16	13a
12	Presoaked	71	76	73c
	Control	37	53	45d
	Mean	54c	65c	
21	Presoaked	79	85	82e
	Control	56	85	71e
	Mean	68f	85e	

1/ Means within a row or a column for each data not followed by the same letter are significantly different at the .05 level.

Table 2.--Effect of presoaking on germination of Ocala sand pine seed at soil moisture contents of 5 and 7 percent.

Days after sowing	Treatment	Germination at soil moisture level 5-percent	7-percent	mean
			Percent	
7	Presoaked	18	29	24a[1/]
	Control	8	15	12b
	Mean	13a	22b	
14	Presoaked	25	58	42c
	Control	25	42	34c
	Mean	25c	50d	
21	Presoaked	25	61	43c
	Control	25	49	37c
	Mean	25c	55d	

1/ Means within a row or a column for each data not followed by the same letter are significantly different at the .05 level.

Seed losses to predators can and often are a substantial problem in artificial regeneration of Ocala sand pine stands by direct seeding. Cooper et al. (1959) concluded that the loss of seed to rodents, birds, and ants was the single largest obstacle to the successful regeneration of Ocala sand pine by artificial seeding. Presoaking Ocala sand pine seed before sowing seems to be a simple way to speed up the rate of germination. This would be advantageous under field conditions since the sooner the seed germinates and begins growth the less time it is exposed to the dangers of predation. In addition this study indicates that under some conditions presoaking may also increase total germination.

One of the possible disadvantages of presoaking seeds could be the loss of viability if sown in very dry soils. This could occur if presoaking caused seeds to begin germination at soil moisture levels that were too low for successful completion of seedling emergence or if presoaking changed the physiological state of the seed such that it was more susceptible to damage while lying in the soil waiting for precipitation to raise the soil moisture level enough for germination to occur. In this study, if moisture levels were too low, seeds did not begin germination even if presoaked and there was no evidence that presoaking seeds reduced their viability while lying in soil at low moisture levels. When water was added to soil after 3 weeks of simulated drought conditions both presoaked and control seeds had an equal germination rate, about 53 percent. This was essentially equal to the 55 percent rate for seeds sown in soil which initially had adequate moisture for germination.

Although presoaking Ocala sand pine seeds appears promising it should be tested under field conditions before it is adopted for general use. This will be done very soon by using presoaked seed in one seed box and control seed in the other of a two row bracke seeder on some operational seeding jobs on the Ocala National Forest.

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